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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/588,668	08/30/2006	Josuke Nakata	F-9186	9961

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EXAMINER	
GARDNER, SHANNON M	
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/588,668	NAKATA, JOSUKE	
	Examiner	Art Unit	
	SHANNON GARDNER	1723	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *3* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *11/7/2011 (RCE)*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ An election was made by the applicant in response to a restriction requirement set forth during the interview on _____; the restriction requirement and election have been incorporated into this action.

4)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

5)☒ Claim(s) *1,3,4 and 7-20* is/are pending in the application.

5a) Of the above claim(s) *18-20* is/are withdrawn from consideration.

6)☐ Claim(s) _____ is/are allowed.

7)☒ Claim(s) *1,3,4 and 7-17* is/are rejected.

8)☐ Claim(s) _____ is/are objected to.

9)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

10)☐ The specification is objected to by the Examiner.

11)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

12)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

13)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Continued Examination Under 37 CFR 1.114

1. A request for continued examination under 37 CFR 1.114, including the fee set forth in 37 CFR 1.17(e), was filed in this application after final rejection. Since this application is eligible for continued examination under 37 CFR 1.114, and the fee set forth in 37 CFR 1.17(e) has been timely paid, the finality of the previous Office action has been withdrawn pursuant to 37 CFR 1.114. Applicant's submission filed on 10/6/2011 has been entered.

Response to Amendment

Applicant's amendment of 10/6/2011 (entered by RCE on 11/7/2011) does not render the application allowable.

Remarks

Applicant has amended claims 1, 4, 8, and 16, cancelled claims 2, 5, and 6. Claims 18-20 remain withdrawn as per a previous restriction requirement. Claims 1, 3-4, and 7-17 are pending in the application and are considered on their merits below.

Status of Objections and Rejections

All objections and rejections from the previous office action are withdrawn in view of Applicant's amendments. New grounds of rejection, necessitated by the amendments, are set forth below.

Claim Rejections - 35 USC § 112

2. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

3. Claims 1, 3-4, and 7-17 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

As to claim 1, it is unclear as to what Applicant intends by "a serial/parallel connection circuit for electrically connecting said plural nearly spherical solar cells in each row or column in parallel via a pair of lead wires and for electrically connecting said plural nearly spherical solar cells in each column or row in series" (lines 15-18). It is unclear as to whether Applicant intends each row or column to be independently connected as per a design choice, or if all rows are to be connected serially (or in parallel) with all columns connected in parallel (or serially) as a group. Appropriate clarification and correction is required.

Claims 3-4 and 7-17 depend (either directly or indirectly) from base claim 1 and are rejected under the same grounds as detailed above.

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

5. The factual inquiries set forth in *Graham* v. *John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.

2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

6. Claims 1, 3, 7-10 and 16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nakata (US 6204545) in view of Alvi (*The Potential For Increasing The Efficiency Of Photovoltaic Systems By Using Multiple Cell Concepts)* and Freundlich (US 6150604), as evidenced by Nath (US 4773944).

As to claim 1, Nakata is directed to a semiconductor device comprising:

- Solar cell modules (200) being incorporated in an integrally laminated structure (by resin 242A) wherein
- The solar cell module comprises a plurality of nearly spherical solar cells aligned in plural rows and plural columns (shown in Figure 26) which are extending crosswise to a direction of lamination (lamination shown going in a direction into the page in Figure 26, rows and columns both shown crosswise).

Nakata goes on to teach that the semiconductor device can have a plurality of spherical elements and other compositional elements (column 3, lines 35-38) formed into a sheet or panel (column 24, line 62 to column 25, line 1), and the device is easily modifiable with the strength of the generated voltage being chosen freely (column 3, lines 59-60 and column 5, lines 11-13). The Nakata reference discloses the use of Si and GaAs materials (column 19, lines 27-40) in a device that allows light to be received from all surfaces except at electrodes leaving no limitation on the direction of incoming

light (column 23, lines 64-66). The reference further discloses both series and parallel interconnections (column 25, lines 26-45).

Nakata fails to teach different types of solar modules with different sensitivity wavelengths.

Alvi is directed to a laminated (layered) solar battery (Figure 1), comprising:

- Different types of solar cell modules each having a respective different sensitivity wavelength band and each configured generally in a form of a layer (see Figure 1 and abstract – Si, GaAs, GaP are disclosed on pp 953 and 956),
- The solar cell modules being incorporated as an integrally laminated (layered) structure in which the solar cell modules are consecutively layered from an indicated side of the structure for receiving sunlight in an order according to shortness of a center wavelength of each solar cell module (ordered in optical series; abstract), wherein
- A solar cell module having the shortest center wavelength is located closest to the indicated side to improve device efficiency (abstract).

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to utilize multiple solar module sheets (having spherical elements) of Nakata configured in a stacked multi-layered device having different types of solar cell modules (Si and GaAs disclosed by Nakata) being ordered in optical series to improve device efficiency as taught by Alvi. The Examiner notes that a direction of lamination of the solar cell modules is the same as a layer of stacking (in this case up

and down relative to incident light). As such, the rows and columns of Nakata's sheet (Figure 26) are still extending crosswise (within a given panel/plane) to a direction of lamination.

Nakata in view of Alvi fails to teach the spherical cell group module being connected in a serial/parallel connection circuit with the solar cell modules being electrically connected in series such that the different types of solar cell modules are configured such that designed maximum output current of the solar cell modules are approximately equal to each other.

A skilled artisan would appreciate that there are a finite number of electrical connection configurations (series, parallel, series-parallel). As such, a skilled artisan would have been motivated to select an appropriate electrical connection to achieve desired electrical characteristics for the device. As is known in the art, series connections are selected for increased voltage whereas parallel connections are selected for increase power/current, as evidence by Nath (column 18, lines 19-47) (see MPEP § 2141 and KSR rationales). Further, it is known in the art to match output current of connected solar cells in a solar module to prevent one solar cell from limiting the overall device output.

Therefore, a connection circuit in which each row or column is connected in parallel and each column or row is connected in series with adjacent solar cell modules being connected in series with output currents matching is considered a matter of design choice and would have been within purview of a skilled artisan at the time of the invention.

Modified Nakata in view of Alvi fail to teach at least one planar light receiving module. Though Alvi does disclose that in order to increase the efficiency of a photovoltaic system, it is known to utilize multiple types of solar cells to capture as much incident light as possible as well as attempting to absorb the majority of light passing through a cell (abstract).

Reading the references as a whole, a skilled artisan would appreciate that the references are directed to capturing as much light as possible in the multi-layered device. As such, one of ordinary skill in the art would have found it obvious to provide a planar light receiving module (layer; such as in Alvi's Figure 1) at the back (furthest from incident light) of the multi-layered device of the prior art to capture any light not utilized by the spherical solar cells of modified Nakata's device thus increasing overall device efficiency, as taught by Freundlich who shows a planar common pn junction (12/16) with a reflective mirrored surface (10) in a solar module device utilized to absorb wavelengths of light not absorbed above and then to reflect back unabsorbed light (Figure 1).

Regarding claim 3, modified Nakata teaches the selection of a number of spherical semiconductor devices to achieve a desired output voltage and current (column 25, lines 42-45 and column 3, lines 35-38). Thus, the selection of three layers/panels having spherical solar cells (Nakata's Figure 26) and one planar common pn junction is within purview of a skilled artisan to achieve a desired output voltage and current.

Regarding claim 7, modified Nakata teaches each cell group module including two layer of nearly spherical solar cells aligned in columns and rows on respective planes running crosswise to the lamination direction (it is noted that two adjacent panels/sheets read on one cell group module) (see Figure 26) but does not specifically teach the nearly spherical solar cells arranged in two layers so at to not overlap when viewed in the direction of lamination.

A skilled artisan would appreciate that there are a finite number spherical cell alignments (directly aligned or set apart). As such, a skilled artisan would have been motivated to select an appropriate alignment to achieve desired characteristics for the device. Specifically, setting adjacent panels/layers askew such that the spherical solar cells of adjacent layers do not overlap when viewed in the direction of lamination allows more incident light on spherical solar cells not directly adjacent to the incident light. As is known in the art, more incident light allows for better conversion efficiency (see MPEP § 2141 and KSR rationales).

Therefore, the alignment of spherical solar cells in two adjacent cell group module panels/layers being set to not overlap when viewed in a direction of lamination is considered a matter of design choice and would have been within purview of a skilled artisan at the time of the invention.

Regarding claim 8, modified Nakata teaches the planar light receiving module (12/16 of Figure 1) being arranged in the lowest layer to be located downside of the plural cell group members of Nakata's Figure 26 and thereon is provided with a

reflective member (10) capable of reflecting the sunlight downside of the planar light receiving module.

Regarding claim 9, modified Nakata (by Freundlich) teaches a mirror film on the backside of the cell (column 3, lines 39-44) but is silent as to the mirror film reflecting a light of sensitivity wavelength bands that can easily be absorbed by solar cell modules above any solar cell module.

Alvi teaches the use of "selective mirrors" to divide the solar spectrum into energy bands that selected cells can respond to (claim 9) as a means of improving cell efficiency.

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to include the selective mirror(s) of Alvi in the modified device of Nakata (specifically as the modified mirror of Freundlich) to provide the best cell efficiency.

Regarding claim 16, modified Nakata in view of Alvi fail to teach at least one planar light receiving module including two types of planar light receiving modules having one or more cell group modules incorporated between the two types. Though Alvi does disclose that in order to increase the efficiency of a photovoltaic system, it is known to utilize multiple types of solar cells to capture as much incident light as possible as well as attempting to absorb the majority of light passing through a cell (abstract).

Reading the references as a whole, a skilled artisan would appreciate that the references are directed to capturing as much light as possible in the multi-layered device. As such, one of ordinary skill in the art would have found it obvious to provide a

planar light receiving module (layer; such as in Alvi's Figure 1) at the back (furthest from incident light) of the multi-layered device of the prior art to capture any light not utilized by the spherical solar cells of modified Nakata's device thus increasing overall device efficiency, as taught by Freundlich who shows a planar common pn junction (12/16) with a reflective mirrored surface (10) in a solar module device utilized to absorb wavelengths of light not absorbed above and then to reflect back unabsorbed light (Figure 1).

As such, a skilled artisan would have found it a matter of design choice to include a desired number of planar light receiving modules to absorb desired wavelengths of light "missed" by the above spherical solar device. Further, the arrangement of layers is held by the courts to be a mere matter of design choice (see *In re Japikse* and MPEP § 2144.04).

Regarding claim 10, modified Nakata teaches the solar cells (200) being received in a buried stat inside a synthetic resin material (242A) (column 25, lines 40-59).

7. Claim 4 is rejected under 35 U.S.C. 103(a) as being unpatentable over Nakata (US 6204545) in view of Alvi (*The Potential For Increasing The Efficiency Of Photovoltaic Systems By Using Multiple Cell Concepts)* and Freundlich (US 6150604) as applied to claim 1 above, and further in view of Ishikawa (US 6355873).

Regarding claim 4, Applicant is directed above for a full discussion of modified Nakata as applied to claim 1. Modified Nakata teaches solar cells being aligned in

columns and rows but fails to teach electrical connection via lead wires extending in a columnar or a row direction and being led to an outside.

Ishikawa is directed to spherical shaped solar devices in a panel assembly which utilizes a conductive wire mesh for securing and electrically contacting the solar devices (210) thus the mesh and solar devices are secured together and provide a stable device (column 4, lines 45-64). Ishikawa teaches the use of this wire mesh in conjunction with a resin or adhesive for further stability.

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to use a conductive wire mesh for securing and electrically contact the spherical solar devices of modified Nakata to ensure a stable device with appropriate electrical connection as taught by Ishikawa.

The Examiner notes that the combination of modified Nakata and Ishikawa provides for lead wires (conductive wire mesh) extending in a row or column direction. Further, a skilled artisan would appreciate that the lead wires will lead to an outside of the device to allow for connection to a load, battery, or other desired outside electrical connection.

8. Claim 11-17 rejected under 35 U.S.C. 103(a) as being unpatentable over Nakata (US 6204545) in view of Alvi (*The Potential For Increasing The Efficiency Of Photovoltaic Systems By Using Multiple Cell Concepts)* and Freundlich (US 6150604) as applied to claim 7 above, and further in view of Nakata (WO/2004/001858).

Regarding claim 11, modified Nakata (545) teaches synthetic resin on top and bottom of solar cell modules (200) (Figure 26 and column 25, lines 40-59), but does not

specifically teach a transparent member being fixed at a tope of the solar cell module on the one of the solar cell modules at the incident side of the laminated structure which is adapted to being exposed to light.

Nakata (858) is directed to a solar cell device having spherical solar cells in plural columns and rows utilizing a protective glass film on at least one surface as a covering material on an incident light side (see Figure 6).

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to utilize a glass film on an incident light side of modified Nakata's (545) device to provide protection as taught by Nakata (858).

Regarding claim 17, modified Nakata (545) teaches the laminated solar battery according to claim 1 in a shape approximating a cylinder (Figure 25) but fails to specifically teach laminating the device into the shape of a concentric cylinder.

Nakata (858) teaches forming plural types of solar cell modules in the shape of a cylinder and then laminated in the shape of a concentric cylinder (Figure 26) to achieve light absorption over a wider incident angle range.

Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention to shape the device of modified Nakata (545) into a concentric cylinder to achieve light absorption over a wider incident angle range as taught by Nakata (858) (see Figure 26).

9. Claims 12 and 13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nakata (US 6204545) in view of Alvi (*The Potential For Increasing The Efficiency Of Photovoltaic Systems By Using Multiple Cell Concepts)* and Freundlich (US

6150604) as applied to claim 3 above, and further in view of Alivisatos et al. (US 20030226498).

Regarding claims 12 and 13, modified Nakata in view of Freundlich teaches the planar light receiving module being arranged in the lowest position below the multiple cell group modules (The Examiner notes that the planar light receiving module and mirrored surface of Freundlich is utilized in modified Nakata to capture any light not received by the spherical solar cells thereby increasing the efficiency of the device. Therefore, it would have been obvious to one of ordinary skill in the art to provide this planar module downside of the spherical solar cells), and the three types of cell group modules (Nakata; 200) having the first to third cell group modules laminated sequentially from an incidental side of sunlight.

Alvi teaches the use of 2 or 3 different bandgap material cells ordered in optical series within a single cell module to increase the efficiency of a device (Summary). Alvi further teaches the use of silicon, gallium arsenide and gallium phosphide type materials (pp 953 and 956).

Alivisatos et al. teaches the use of spherical semiconductor nanocrystals in solar cells (abstract and paragraph [0065]) in a binder material (paragraph [0070]). The reference further teaches the use of tandem cells utilizing GaAs, GaP, GaAs, Ge and Si (paragraphs [0003] and [0065]).

One of ordinary skill in the art at the time of the invention would have found it obvious to utilize GaP, GaAs and Si together in a tandem solar cell (as taught by Alivisatos) optically ordered from shortest to longest wavelength absorption (as taught

by Alvi) from an incident side wherein the planar light receiving module has a planar common pn junction formed in an InGaAs semiconductor layer which is formed on an n-type InP semiconductor substrate (as taught by Freundlich; Figure 1).

10. Claims 14 and 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Nakata (US 6204545) in view of Alvi (*The Potential For Increasing The Efficiency Of Photovoltaic Systems By Using Multiple Cell Concepts)* and Freundlich (US 6150604) as applied to claim 3 above, and further in view of Alivisatos et al. (US 20030226498) and Wegleiter et al. (US 6531405).

Regarding claims 14 and 15, Nakata in view of Alvi and Freundlich teaches the planar light receiving module being arranged adjacent to the multiple cell group modules. The three types of cell group modules (Nakata; 200) having the first to third cell group modules laminated sequentially from an incidental side of sunlight. Placing the planar light receiving module in a top layer above the plural cell group modules would have been obvious to one of ordinary skill in the art by simple rearrangement of parts (MPEP § 2144.04 C).

Alvi teaches the use of 2 or 3 different bandgap material cells ordered in optical series within a single cell module to increase the efficiency of a device (Summary). Alvi further teaches the use of silicon, gallium arsenide and gallium phosphide type materials (pp 953 and 956).

Alivisatos et al. teaches the use of spherical semiconductor nanocrystals in solar cells (abstract and paragraph [0065]) in a binder material (paragraph [0070]). The

reference further teaches the use of tandem cells utilizing GaAs, GaP, GaAs, Ge and Si (paragraphs [0003] and [0065]).

Wegleiter et al. teaches the use of a GaAsP semiconductor layer on a GaP substrate in a planar solar device (column 1, lines 32-36).

One of ordinary skill in the art at the time of the invention would have found it obvious to utilize GaP, GaAs and Si together in a tandem solar cell (as taught by Alivisatos) optically ordered from shortest to longest wavelength absorption (as taught by Alvi) from an incident side wherein the planar light receiving module has a planar common pn junction formed in an GaAsP semiconductor layer which is formed on an n-type GaP semiconductor substrate (as taught by Wegleiter et al.; column 1, lines 32-36).

Response to Arguments

11. Applicant's arguments with respect to claim 1 have been considered but are moot in view of the new ground(s) of rejection, necessitated by the amendments. The Examiner notes that the same prior art was used, but in a different manner of rejection.

Contact/Correspondence Information

Any inquiry concerning this communication or earlier communications from the examiner should be directed to SHANNON GARDNER whose telephone number is (571)270-5270. The examiner can normally be reached on Monday to Thursday, 5am-3pm EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Alexa Neckel can be reached on 571.272.1446. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/S. G./
Examiner, Art Unit 1723

/Keith D. Hendricks/
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